DOCUMENT RESUME

ED 249 310 UD 023 808

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TITLE Learning Potential Tests: An Alternative to Intelligence Tests?
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PUB DATE 84
NOTE 14p.; Paper prepared for the Inaugural European Conference on Developmental Psychology (Groningen, Netherlands, August 28-31, 1984); For a related document, see UD 023 809.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Aptitude Tests; *Cultural Differences; Elementary Education; Ethnic Groups; Foreign Countries; Intelligence Tests; Mathematics Achievement; Mild Mental Retardation; *Minority Groups; *Predictive Validity; Pretests Posttests; Special Education; Student Placement; *Test Bias; *Test Validity
IDENTIFIERS *Learning Potential Tests; Netherlands

ABSTRACT

This paper presents preliminary results regarding the predictive validity of learning potential tests administered in an exploratory study in Rotterdam (Holland) concerning the referral of minority students to special education. The central question of the study was why some students of Surinamese, Turkish, and Moroccan origin were placed in schools for the educable mentally retarded (EMR) while others with comparable achievement levels were not. For reasons of comparison, a sample of Dutch students with similar (low) levels of academic achievement also participated. Two learning potential tests were constructed, the first using Raven's progressive matrices, the second consisting of number series in domino notation. The tests were then administered to a sample of elementary school students consisting of the ethnic minority and Dutch children. Although the relatively short training period (about half an hour) in each learning potential test produced a significant increase in the mean posttest scores compared to the mean pretest scores, no increase of predictive validity of the posttest scores could be shown with mathematics achievement as the criterion. Neither were the pretest scores superior in the prediction of school learning. This implies that the reason of this draw is not the criterion per se, but rather the fairly high correlation between pretests and posttests. In this respect, findings were at variance with the outcomes reported in other studies. (GC)

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LEARNING POTENTIAL TESTS: AN ALTERNATIVE TO INTELLIGENCE TESTS?*

Introduction

In general, intelligence tests play an important role in placement decisions about students with severe learning problems. The distinction between students classified educable mentally retarded (EMR) and learning disabled (LD) is likewise primarily based on IQ. For as long as intelligence tests have existed, these instruments have been criticized for several reasons: the weak theoretical basis, the neglect of the cognitive processes, and the far from optimal prediction of future learning in school. One of the central assumptions is that every student has had equal opportunities to acquire the skills that are required in the test and that differences in test scores are attributable to differences in intellectual abilities. In the case of students from ethnic minority groups, and especially students from other-language-dominant homes, this assumption can hardly be maintained. Therefore, with this category of students, the use of traditional intelligence tests, even the so-called nonverbal or culture-fair tests, is seriously questioned.

Since the late sixties the concept of the learning potential test has been developing as an alternative to the traditional intelligence test (cf. Budoff, 1970; Budoff et al., 1971; Babad & Budoff, 1974; Dumont et al., 1982; Feuerstein, 1972; 1979; Guthke, 1972; 1980; Gutjahr et al., 1977; Hegarty & Lucas, 1978; Ruijssenaars & Hamers, 1983; Wimmer, 1977). Specific to the main type of learning potential test is the pretest - training - posttest design. Mostly, materials used in traditional nonverbal tests are applied, for example

UD023808

* Paper prepared for the Inaugural European Conference on Developmental Psychology, Groningen, August 28 - 31, 1984

Kohs' Block designs and Raven's Progressive matrices. In the pretest these are administered in the standard way. In the training phase, similar problems are taught, individually or in group sessions. The posttest, equal to the pretest or consisting of a parallel form, is administered shortly after the training session. This training session, in which primarily problem solving strategies are taught, can have different functions. In Vygotski's terms, the 'zone of next development' is explored. In the case of minority students, the training can also reduce the influence of irrelevant differences between students in prerequisite skills, such as understanding instructions, etc. As a consequence of the training, the posttest is expected to be a better predictor of future learning than the pretest. Although the evidence is not complete and some authors express doubts (cf. Dumont et al., 1982; Flammer, 1975; Hamers & Ruijssenaars, 1982; Kormann & Sporer, 1983), the concept of the learning potential test seems to offer a promising perspective for further research.

In 1983 we started an exploratory study in the city of Rotterdam concerning the referral of minority students to special education. The central question in this study was why some students of Surinamese, Turkish and Moroccan origin were placed in schools for the EMR, while others, with comparable achievement levels, were not. For reasons of comparison, a sample of Dutch students with similar (low) levels of academic achievement also participated. Since the ultimate goal of the project was the development of adequate procedures and assessment instruments, two learning potential tests were included in the study. In this paper I will present some results of the preliminary analyses on the data of the learning potential tests.

Sample

The study was started in the spring of 1983 with a stepwise reading and mathematics achievement screaning in all nine Rotterdam EMR schools. Students classified as non-readers and/or who had not yet reached a minimal level of numeracy (teacher ratings) were excluded and assigned the level code 1. The reading and mathematics level of all other students under the age of twelve

was classified by means of tests. Students were given a higher level test only if at least 70% of the items of the preceding one had been answered correctly. The top level (5) roughly corresponds with the level which is reached by the modal student by the end of grade 2. Only ten students out of a total of 313 Dutch, Surinamese, Turkish, and Moroccan students received classifications for reading and/or mathematics higher than 5. Of the remaining students 202 were of Dutch origin, 54 of Surinamese, and 47 of Turkish or Moroccan origin.

The same stepwise procedure was carried out in a sample of 56 elementary schools that had agreed to participate in the project. The sample of schools was stratified by percentage of minority enrollment. Each teacher in grades 2 - 5 selected two or three of the students with the lowest level of academic achievement, while the non-readers and the students who had not yet reached the stage of initial mathematics were identified in grade 1. Out of a total of about 800 students, 243 under the age of twelve were identified with achievement classifications comparable to the EMR students, keeping age constant. Of these 243 regular education (RE) students, 83 were of Dutch origin, 33 of Surinamese origin, and 127 of Turkish or Moroccan origin.

From these pools of EMR and RE students, about 50 from each ethnic group were selected for participation in the main part of the study which was carried out in the school year 1983/84. When less than 50 students were identified, all available students were included in the sample.

Learning potential tests and criterion

Two learning potential tests were constructed, the first using Raven's Progressive matrices, the second consisting of number series in domino notation.

In the training phase of the Progressive matrices test, 21 problems similar to the problems in the colored series A, Ab, and B were used in board form. After the presentation of a new problem, the child was requested to verbalize what the correct piece must look like without seeing the alternatives. Then

the six alternatives were uncovered and the child made his choice. The test assistant then put the chosen piece in the hole and asked whether this really was the correct one. Again the (right or wrong) choice was verbalized. Four trials were allowed for each problem. Special attention was given to the 2 x 2 analogy problems, e.g. by building up the problem with only the upper left hand piece given and by exchanging the upper right hand piece and the lower left hand piece. To quantify the results of the training phase, each problem was given a score of 0 - 4, depending on tha numer of trials needed to arrive at the correct answer. The test assistant also filled out a checklist on motivation, concentration, etc.

Prior to the pretest of the Number series test, a check was made to determine whether the child could readily count backward and forward from and to six and was able to identify the numbers 1 - 6 in domino notation. If so, the pretest was given. In the introduction domino blocks (cut into halves) and sticks of different length (1 - 6 units long) were used to clarify the instructions. The pretest consisted of 30 problems in book form with one number left out of series of six, eight, or nine numbers. The missing number could occur anywhere in the series. As in the posttest, a parallel form of the pretest, the child had to mention the missing number or to point at one of the numbers 1 - 6 presented in domino notation on a separate sheet. In the training phase 20 similar problems with dominoes were presented. Depending on the trial number, the help provided by the test assistant when the answer was wrong after the first three of the four allowed trials, consisted of three forms:

trial 1 - reading aloud the series in a rhythmical way;

trial 2 - forming groups of blocks (two or three blocks into a group, depending on the structure of the problem);

trial 3 - illustrating the problem by laying down sticks of corresponding length above the dominoes.

A final check was provided by splitting the series spatially into (two or three) subseries on different rows. If the child provided the right answer before the fourth trial, he or she was requested to check his or her answer

with the same means used by the test assistant in the help procedure. This check could be shortened, but the final check was always requested. The training phase of the Number series test was scored in the same way as the matrices training phase, and the checklist was also filled out again.

In order to check the effect of mere retesting a control group was to be used. Since this could not be realized, the Progressive matrices pretest was administered twice. The first pretest consisted of series A, Ab, and B only, while in the second, as well as in the posttest, series C was also included. After a retention period of one to two months, series A, Ab, B, and C of the Progressive matrices and the pretest form of the Number series test were administered again. The time schedule is shown in Figure 1.

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insert Figure 1 about here

Besides the effect of the training, the most important aspect of the learning potential test is the prediction of future or concurrent school learning. The choice of the criterion poses some serious problems, however. In the training phase rather optimal conditions for learning are created. If the results of these learning experiences, incorporated in the posttest score, are used for the prediction of learning in school, the prediction can be distorted by less than optimal conditions in real life teaching and learning. This holds for EMR schools as well as regular education and these two school types might differ in this respect. A second problem is the choice of the school subject. As the students in our sample, especially the minority students, are of low proficiency in Dutch, this factor by itself might be an obstacle to learning in school. In the training phase of the learning potential tests an attempt was made to overcome this barrier by using concrete materials as much as possible. However, in most studies in this field teacher ratings or achievement test scores are used as criterion. Therefore, we chose the mathematics achievement test administered in the period May - June as the criterion, mathematics being the school subject of the least verbal character. The two parts of the test cover the content normally taught in grades 1 - 3

(mainly addition and subtraction problems). If on the first 20 items no more than 10 were answered correctly, the second part of 40 items was not given.

Results

Traditional test and item analyses were performed on the newly constructed tests for each of the ethnic groups. The results were quite satisfactory. The internal consistency coefficients of the 30 items pretest, posttest and retention test of the Number series test, for instance, were all higher than 0.80. The Number series training test showed coefficients around 0.80 and the coefficients for the Progressive matrices training test were of the same magnitude. The Progressive matrices tests were assumed to be of acceptable reliability (cf. Raven et al., 1977).

The first questions to answer concern the effect of the training phase in each of the two learning potential tests used:

- What is the magnitude of the gain from pretest to posttest and how does this compare with the effect of retesting?
- Is the gain from pretest to posttest maintained from posttest to retention test?
- Are there any differences in gain between ethnic groups?
- Do some students within ethnic groups profit more from the training than others, or: is the correlation between pretest and posttest lower than the correlation in the case of simple retesting?

I will try to answer these questions with data from preliminary analyses on each of the ethnic groups (Dutch group, n = 82; Surinamese group, n = 75; Turkish/Moroccan group, n = 81).

The pre and posttest of the Number series test consist of items with parallel problems. As the forms were not equated, the first three questions, strictly speaking, cannot be answered with data from this test. The mean differences between the retention test and the pretest, which consist of the same form, are about 3.5 for each of the ethnic groups. This is about two

thirds of the standard deviation of the pretest and highly significant (a difference of slightly more than 1 score point is already signigicant at the 1% level in a one-tailed t-test between these correlated means). The mean retention test scores are almost on the same level as the mean posttest scores. From this finding it can be supposed that the gain took place between pre and posttest and was maintained from posttest to retention test. This is in accordance with the findings on the matrices tests (Figure 2).

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insert Figure 2 about here

With a standard deviation between 4 and 5 on pretest 1, the gain from pretest 1 to pretest 2 amounts to about one fifth to one third of a standard deviation, which is statistically significant beyond the 1% level. The training session adds a statistically significant gain of about one half standard deviation to this effect for each ethnic group, which is maintained in the Dutch and the Surinamese groups until the retention test. The Turkish/ Moroccan group even shows a further gain of about one fourth of a standard deviation. From this data it can be concluded that the trainin, sessions were effective in producing a significant increase in the mean score level, with slight differences between ethnic groups.

In connection with the prediction of school learning, it is important to know whether the effect of the training was uniform or differential within ethnic groups. Only when a differential effect appears, can there be significant differences in the predictive validity between pre and posttest. This can be observed from the correlations between the various testing moments as well as the standard deviations of the differences in the case of identical tests. The correlations are presented in Table 1.

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insert Table 1 about here

The correlation between pretest 2 and the posttest of the Progressive matrices test is at the same level as the correlation between pretest 1 and pretest 2 for each ethnic group and the same holds when the former

correlations are compared with the correlations between posttest and retention test. Although the correlations are at a somewhat lower level, the same picture emerges for the Number series test. It can be concluded that the effect of the training is rather uniform compared to the effect of simple retesting. This also appears from the standard deviations of the differences on the Progressive matrices test, which are invariably of a magnitude of about 3.

The second main question concerns the comparison of the relations between the various tests and the criterion: mathematics achievement. Since it does not make much difference whether set C is included in the Progressive matrices scores or not, the data are restricted to the sum scores on sets A, Ab, and B. The zero order correlations with mathematics achievement are presented in Table 2 for each ethnic group and school types within ethnic groups.

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insert Table 2 about here

As could be expected from the data in Table 1, the differences between the correlations with mathematics achievement at the various moments are small. The prediction by the Number series posttest is in all cases, except one, lower than the prediction by the pretest, while only in one case (Turkish and Moroccan EMR students) the prediction of the Progressive matrices posttest is considerably better than pretest 1 as well as pretest 2.

In Table 2 the zero order correlations with the criterion are presented, without considering the influence or third variables that could have variance in common with both the predictors and the criterion. Such variables might be age or previous level of mathematics achievement. As the relations of such variables with pretest and posttest might differ, this could mask differences in predictive validity between pretest and posttest. Therefore, we also calculated the first order partial correlations of the various tests with mathematics achievement, with the effect of previous achievement level removed. Consider, for example, the following case based on data of the

Turkish/Moroccan group (Figure 3).

insert Figure 3 about here

The correlation between posttest and criterion is reduced to 0.28 when the effect of the previous level of mathematics achievement is removed. The partial correlation between pretest and criterion is 0.25, which leaves a difference of only 0.03, the original difference being 0.11 (0.53 - 0.42).

Actually, in this study the test (either pre or post) showing the highest correlation with the criterion, in most cases also shows the highest correlation with previous level of achievement. In some instances the direction of the difference in predictive validity between pre and posttest was reversed when the effect of previous level of achievement was partialled out. The full list of partial correlations appears in Table 3.

insert Table 3 about here

The proportion of variance explained by the Number series posttest after the removal of the effect of previous achievement level is not very impressive (less than 10%) and certainly not larger than the proportion explained by the pretest. In the case of the Progressive matrices tests, a clear superiority of the posttest does not appear, either.

Conclusion

Although the relatively short training period (about half an hour) in each learning potential test used produced a significant increase in the mean posttest scores compared to the mean pretest scores, no increase of predictive validity of the posttest scores could be shown with mathematics achievement as the criterion. It should be noted that the pretest scores were not superior in the prediction of school learning, either. This implies that the reason of this draw is not the criterion per se. The main reason must be the rather high correlations between pretests and posttests. In this respect our findings are at variance with the outcomes reported in other studies. This difference

does not lie in the characteristics of the sample under study. Budoff (1970) has stressed that the learning potential test is most suitable for low ability students and he based the distinction between mentally retarded and educationally retarded students on the difference in gain from pretest to posttest.

Guthke (1972, p. 138) admits that the gain in prediction (mostly teacher ratings in the studies he reports on) is rather small and statistically not significant in most cases, but the gain is consistent across quite a number of studies (cf. Flammer, 1975; Guthke, 1980). In these and most other studies the relation of both pre and posttests with the level of prior achievement is neglected, however. Higher correlations between posttest and criterion might coincide with higher correlations between posttest and prior level of achievement. In our study this is the most common pattern. In such cases the differences between partial correlations, with the effect of previous level of achievement removed, are smaller than the differences between pre and posttest zero order correlations with the criterion. The direction of the difference can even be reserved, as is shown. So, the slightly better prediction of school learning by the posttest in the studies reported by various authors could be an artefact of the differing relation with a third variable, i.e. previous level of achievement. The findings reported in this study indicate that the learning potential test concept needs reconsideration. At this point I wonder whether this kind of test can be an alternative to the traditional intelligence test in the prediction of school learning.

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Figure 1 Time schedule of the learning potential tests

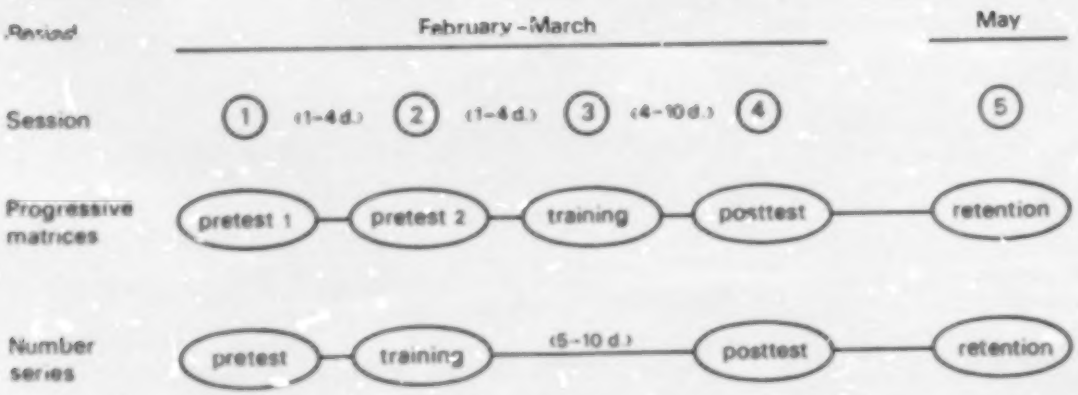


Figure 2 Mean differences between scores on the Coloured progressive matrices (sets A, Ab, B) for each of the ethnic groups

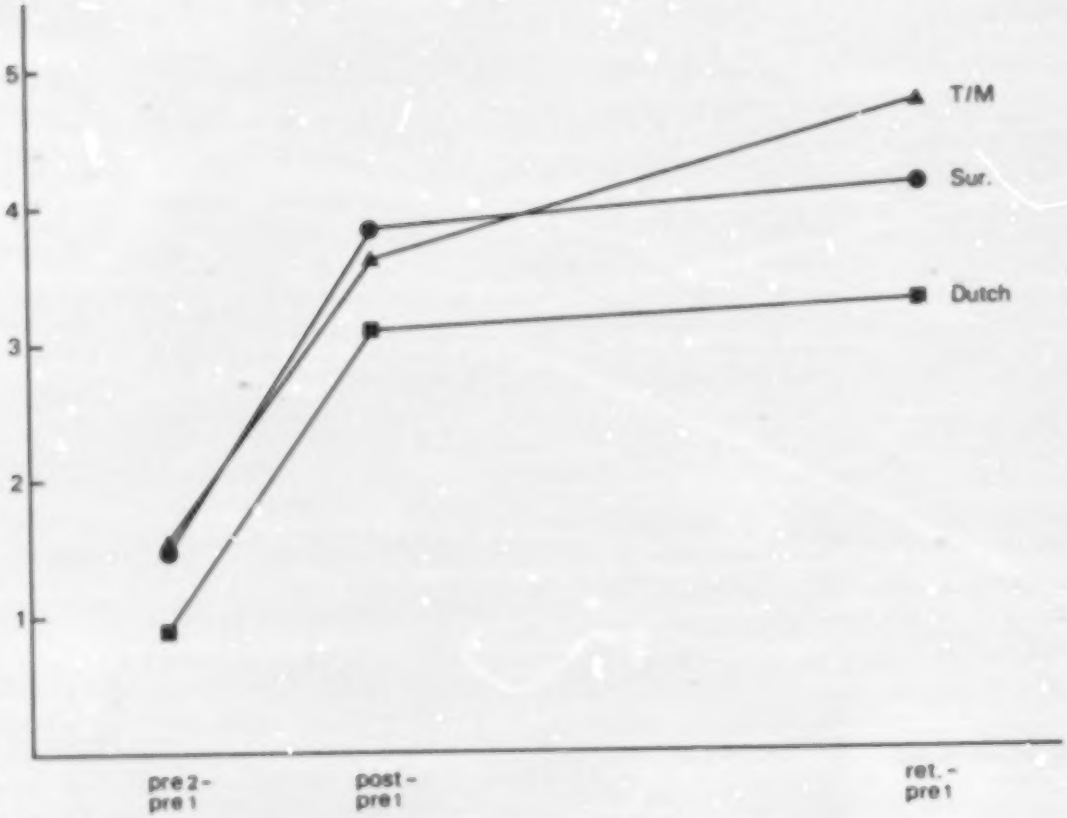
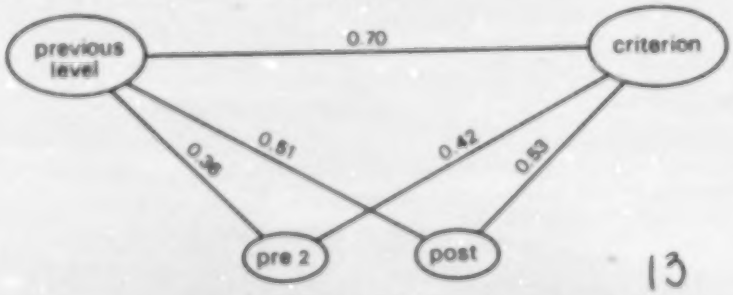


Figure 3 Example of different relations of pre and posttest with the criterion and previous level of achievement



Progressive Matrices

Table 1 Correlations between testing moments for each ethnic group (decimals omitted)

	Dutch	Surinamese	Turkish/Moroccan
Progressive matrices			
Pretest 1 - Pretest 2	82	77	75
Pretest 1 - Posttest	78	71	71
Pretest 1 - Retention test	75	74	73
Pretest 2 - Posttest	83	79	77
Pretest 2 - Retention test	78	77	73
Posttest - Retention test	83	78	84
Number series			
Pretest - Posttest	61	74	65
Pretest - Retention test	67	66	62
Posttest - Retention test	65	59	67

Table 2 Zero order correlations of pre and posttests with mathematics achievement for each ethnic group and school types within ethnic groups (decimals omitted)

	Progressive matrices			Number series	
Group	Pre 1	Pre 2	Post	Pre	Post
Dutch, EMR	56	49	56	60	56
Dutch, RE	34	34	40	22	11
Dutch, total	49	44	55	52	50
Surinamese, EMR	6[illegible]	68	65	62	58
Surinamese, RE	59	50	64	43	48
Surinamese, total	60	56	63	57	56
Turkish/Moroccan, EMR	47	45	72	62	57
Turkish/Moroccan, RE	46	42	40	54	37
Turkish/Moroccan, total	48	42	53	61	55

Table 3 First order partial correlations of pre and posttests with mathematics achievement for each ethnic group and school types within ethnic groups, the effect of previous achievement removed (decimals omitted)

	Progressive matrices			Number series	
Group	Pre 1	Pre 2	Post	Pre	Post
Dutch, EMR	37	37	34	33	27
Dutch, RE	19	14	18	21	- 07
Dutch, total	29	25	32	37	26
Surinamese, EMR	11	44	37	11	11
Surinamese, RE	30	07	42	05	14
Surinamese, total	23	17	36	18	21
Turkish/Moroccan, EMR	09	15	39	26	28
Turkish/Moroccan, RE	34	37	38	36	14
Turkish/Moroccan, total	27	25	28	38	34